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UNDERSTANDING THE INNOVATION PROCESS IN MANUFACTURING

Innovation is accepted as one of the important factors stimulating economic and employment growth in Australia and helping Australian businesses compete in international markets. To enhance business growth and competitiveness, government aims to encourage and assist businesses to be innovative. Information about the innovation process is vital to the development and evaluation of government policy in this area. Until recently little was known about the likelihood of a business to be innovative, or about the reasons why a business does or does not undertake innovation.

The ABS conducted its first innovation survey in respect of 1993-94, gathering some basic information about the innovation process in Australia. The survey, which followed international guidelines for the conduct of innovation surveys, focused mainly on technological innovation, that is technologically new, or substantially changed, products or new, or substantially changed, processes. It measured the innovation status of businesses (i.e. their propensity to undertake innovation) over a three year period (1991-92 to 1993-94). The ABS also sought some information about non-technological innovation, that is innovation in organisational and managerial aspects, and broadened the survey's scope to collect information about the rate of innovation in the services sector.

This article presents some findings from the ABS survey regarding technological innovation in the manufacturing sector, in terms of the sources for the impetus to innovate and the reasons why some businesses choose to be innovative while others do not. Differences in the innovation process between small businesses (less than 20 employees), medium sized businesses (between 20 and 99 employees) and large businesses (100 or more employees) are highlighted.

What proportion of manufacturers innovate?

The survey showed that only one third of manufacturers in Australia were technologically innovative. The likelihood that a business was innovative appears to be strongly related to the employment size of the business. Large businesses were more than twice as likely to be innovative as small businesses. Also, compared to small businesses, a higher proportion of large businesses were innovative in relation to both products and processes (table S4.1).

S4.1 PROPORTION OF MANUFACTURERS UNDERTAKING TECHNOLOGICAL INNOVATION

Innovation type			
Product only	Process only	Product and process	Total undertaking technological innovation

Business size	%	%	%	%
Small	10.7	3.4	15.0	29.1
Medium	10.0	6.0	37.8	53.9
Large	12.8	7.8	58.7	79.3
All	10.7	3.8	19.2	33.7

Source: Innovation in Australian Manufacturing (8116.0), unpublished data.

Although a minority of manufacturers reported undertaking innovation, over 70% of the manufacturing workforce is employed by businesses undertaking technological innovation. This proportion increases from one third of the manufacturing workforce employed by small businesses, to over half that employed by medium sized business, and over 85% of that employed by large businesses. The overall proportion is considerably higher than the proportion of businesses innovating (table S4.1) due to the strong positive correlation between employment size and the proportion of innovators. The number of workers directly involved in innovation is not known.

The degree of influence of other business characteristics on the overall proportion of businesses undertaking technological innovation is difficult to quantify. If the likelihood that a business has a particular characteristic is related to employment size, then the effects of employment size and the other characteristic are difficult to separate. Of note are those characteristics which increase the exposure of a business to overseas market influences - such as export status, foreign ownership and foreign competitors. For example, the proportion of exporters undertaking technological innovation was almost 70% compared to only 25% for non-exporters. However, while the difference in the proportions of businesses innovating, between exporters and non-exporters is around 40% for small businesses, it drops to 20% for large businesses. It appears that exporter status has less influence on the propensity to be innovative as employment size increases. These relationships are shown in table S4.2.

S4.2 PROPENSITY TO INNOVATE, By Characteristic and Size of Business

Business size				
	Small %	Medium %	Large %	All %
Exporter	64.5	69.8	85.0	68.8
Non-exporter	24.3	42.4	65.7	26.3
Foreign owned	27.7	73.0	93.5	51.1
Australian owned	37.3	70.5	88.9	42.4

Main competitor - foreign	32.0	54.2	78.4	36.7
Main competitor - Australian	50.0	68.4	85.1	56.9

Source: Innovation in Australian Manufacturing (8116.0), unpublished data.

Reasons for not innovating

A range of reasons was given by manufacturers for not undertaking technological innovation. However it is not known how many manufacturers do not even consider undertaking innovation. Only one quarter of manufacturers, both innovators and non-innovators, reported that there were factors which hampered their innovative activity. The two main factors were a lack of finance and the high cost of innovation. Other significant hindrances reported included a lack of skilled personnel; difficulty controlling the costs associated with the innovation; long pay back period; legislation, regulations, standards and taxation; and excessive perceived risk.

While financial considerations appear to be the main factors hampering technological innovation in the manufacturing sector, small businesses reported these factors to be more significant hindrances than larger businesses. Also, the other factors appeared to be less important to small businesses than to larger businesses. There was no consistent pattern in the views of innovators compared to non-innovators about the significance of any of the factors in hampering technological innovation.

On the other hand, a number of factors were reported as being unimportant in hindering technological innovation. The majority of businesses indicated that their earlier innovations did not remove the need for future innovation. As shown in table S4.3, about half of the businesses considered many other factors to be unimportant.

S4.3 FACTORS HAMPERING INNOVATION, Proportion of Manufacturers Rating Them as Unimportant

	Business size			
	Small %	Medium %	Large %	All %
Lack of skilled personnel	43.3	19.3	15.0	37.0
Lack of information on technologies	51.0	33.7	24.9	46.0
Lack of information on markets	48.9	35.0	31.0	45.2
Deficiencies in the availability of external	59.0	47.2	41.1	55.6

technical services				
Lack of opportunity for cooperation with other companies and scientific/ technological organisations	61.6	52.2	50.6	59.2
Innovation costs hard to control	40.9	31.7	32.8	38.7
Resistance to change in the business	64.7	38.0	24.4	57.0
Excessive perceived risk	41.2	32.0	28.2	38.6
Lack of appropriate sources of finance	27.4	28.7	36.6	28.3
Innovation costs too high	28.8	27.4	24.9	28.3
Pay back period of innovation too long	41.5	34.0	25.1	38.9
Lack of technological opportunities	65.2	50.3	46.6	61.2
No need to innovate due to earlier innovations	77.2	73.8	68.2	75.9
Innovation too easy to copy	58.3	59.5	54.3	58.2
Legislation, regulations, standards, taxation	46.2	45.5	44.4	45.9
Lack of customer responsiveness to new	49.7	44.8	43.1	48.3

products and
processes

Uncertainty in timing of innovation	55.6	49.7	39.4	53.3
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Source: Innovation in Australian Manufacturing (8116.0), unpublished data.

Given the financial hindrances associated with innovation, the actual amount spent on innovation is of interest. Table S4.4 shows, for businesses undertaking technological innovation, the sales and the innovation costs per employee. Also included is the ratio of innovation costs to sales, expressed as a percentage. Large businesses show higher sales per employee, while small businesses show a much higher value for the ratio of innovation costs to sales per employee. The higher proportion of innovation costs for small businesses is related to their relatively short time in operation. Consequently the relatively large costs of innovation per employer for small businesses might be attributed to the relative lack of diversity in their business activities.

S4.4 BUSINESS SALES AND INNOVATION COSTS PER EMPLOYEE

Business size	Sales \$'000	Innovation costs \$'000	%
Small	153	11	7
Medium	169	7	4
Large	247	8	3
All	225	8	4

Source: Innovation in Australian Manufacturing (8116.0), unpublished data.

What sources of ideas lead businesses to innovate?

For those manufacturers undertaking technological innovation, the main sources of ideas and information which lead to innovation are linked to their day to day operations. Although internal research and development (R&D) has long been considered a major source for technological innovation, it is not the only significant source. Other important sources include requests from and the expectations of clients/customers; the innovations of other businesses in the same industry; suppliers of materials, components and equipment; and other areas within the business not involved in R&D.

Most manufacturers undertaking technological innovation reported obtaining their ideas and information from a small number of sources. For example, one in six technological innovators did not view any single source as very significant while another 40% viewed only one or two sources as being very significant. The majority of innovators considered most sources to be unimportant in providing the impetus for technological innovation. The exceptions were the sources 'clients/customers' and 'R&D', which were, respectively, considered to be unimportant by only 10% and one third of technological innovators.

Compared to small businesses, larger businesses tended to place more importance on individual

sources. The exception was the source 'clients/customers'; there were virtually no differences in the significance attributed to this source by businesses of different sizes. This contrasts with 'R&D', which was rated as more important than 'clients/customers' by almost 40% of large businesses but by only one quarter of small and medium businesses.

What objectives lead business to innovate?

Just as technological innovation can arise from many different sources, there are also many objectives in undertaking innovation. Improving product quality was seen as the most significant objective of technological innovation, and the least important was to increase overseas market share. Extending product range within main product field was another significant objective, but extending products outside of the main product field was viewed as unimportant. Other significant objectives included maintaining and increasing market share, while objectives considered insignificant included replacing phased out products, reducing energy consumption or environmental damage and meeting government standards, regulations and legislation.

The larger the employment size of the business the greater was the reported importance given to technological innovation in helping to create new overseas markets. The size of the increase is due mainly to the strong relationship between the proportion of exporters who are technological innovators and their employment size. As employment size increases, the proportion of exporters rises, causing the importance of the objective to become more significant. Looking only at exporters among the technological innovators, there is a slight increase in the importance of the objective across the different sizes of business.

Other objectives increased their importance as employment size increased. Again exporters gave more significance to individual objectives than non-exporters, although the increase in importance across sizes was more noticeable among the non-exporters. There appeared to be no difference attributable to employment size in the number of objectives that innovators viewed as significant, though that number is not small. For example, over half the innovators considered at least four objectives to be very significant.

Effects of innovation on business performance

The growth in business performance resulting from technological innovation has not yet been measured adequately. Identifying innovators at a single time point only allows a comparison of the levels of performance between innovators and non-innovators. Before the rates of growth for innovators and non-innovators can be compared a second survey is required at a later time point to measure change. Consequently little can be said currently about whether innovation improves business performance.

Table S4.5 presents some data for the performance measure labour productivity, defined as the value of production per employee. The table shows that there appear to be differences in average labour productivity as between innovators and non-innovators. However, these difference are not statistically significant since there are high standard errors associated with the averages.

S4.5 LABOUR PRODUCTIVITY (PRODUCTION PER EMPLOYEE)

Business size	\$000	\$000	\$000
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Small	42.0	36.6	38.5
Medium	56.5	48.8	53.5

Source: Innovation in Australian Manufacturing (8116.0), unpublished data

Summary

The 1993-94 survey identified some of the characteristics of innovating businesses, still in the minority among Australian businesses.

Technological innovation is more prevalent among larger manufacturers. These businesses are likely to have been at least ten years in existence and involved in exporting. The larger manufacturers' more substantial operations and greater propensity to export appear to alter the way they view the innovation process. Large manufacturers have more funds available to support internal R&D and to bear the other costs associated with innovation. Compared to the smaller innovators, larger innovators report fewer barriers to undertaking innovation and are more positive about the objectives that innovation can help their business to achieve. Their aims include increasing their presence in overseas markets as well as improving product quality and expanding their product range.

Over 70% of all technological innovators in the manufacturing sector are small businesses. These businesses are probably in their first ten years of operation, and likely to be still finding and consolidating their place in the market. Consequently they are interested in using innovation to maintain or increase their market share in Australia by improving product quality or by expanding their product range. Given the small size of these manufacturers' operations and income, cost and financing difficulties are the biggest barriers to undertaking technological innovation. These manufacturers are unlikely to have funds available to support internal R&D, and gain the impetus for innovation from other sources associated with the operations of the business.

The question of the growth in performance for particular types of business resulting from innovation has yet to be answered. Similarly, little is known yet about the innovation process; in particular, what assists an innovation to reach the stage of successful implementation, how innovations become diffused through the business sector, and whether the originality of the innovation affects the growth in business performance. Unfortunately, what is still unknown about the innovation process is also important to the formulation of effective government policy in this area.

The ABS is currently developing a second round of innovation surveys that will be designed to both enhance and extend the information currently available. The surveys will repeat the collection of data in the manufacturing sector and expand the information collected in both the services and manufacturing sectors. The surveys will relate to the 1996-97 reference year.

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